VNIVERSITAT DE VALÈNCIA

Course Guide
43100 Metabolic regulation in mammalian cells

COURSE DATA

Data Subject	
Code	43100
Name	Metabolic regulation in mammalian cells
Cycle	Master's degree
ECTS Credits	4.5
Academic year	2021 - 2022

Study (s)

Degree	Center	Acad. year	Period
2142 - M.U. en Aproximaciones Moleculares CC Salud 12-V.2	Faculty of Biological Sciences	1	First term

Subject-matter

Degree	Subject-matter	Character
2142 - M.U. en Aproximaciones Moleculares CC Salud 12-V.2	2 - Metabolic regulation and integration	Obligatory

Coordination

Name	Department
O'CONNOR BLASCO, JOSE ENRIQUE	30 - Biochemistry and Molecular Biology
TORRES ASENSI, LUIS	30 - Biochemistry and Molecular Biology
VIÑA RIBES, JUAN	30 - Biochemistry and Molecular Biology

SUMMARY

The aim of this course is to acquire a thorough understanding of the regulation of metabolism and of metabolic interrelationships that exist between the different tissues in mammals and especially in man.

With this goal in different topics of the course will emphasize the following points: (1) Differences between tissue and tissue metabolic flux, (2) control the short and long term metabolism (3) the importance of gene regulation and epigenetics metabolism and (4) how these processes are regulated and coordinated in different physiological and pathological situations.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

None.

OUTCOMES

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- Students should apply acquired knowledge to solve problems in unfamiliar contexts within their field of study, including multidisciplinary scenarios.
- Students should be able to integrate knowledge and address the complexity of making informed judgments based on incomplete or limited information, including reflections on the social and ethical responsibilities associated with the application of their knowledge and judgments.
- Students should communicate conclusions and underlying knowledge clearly and unambiguously to both specialized and non-specialized audiences.
- Students should demonstrate self-directed learning skills for continued academic growth.
- Students should possess and understand foundational knowledge that enables original thinking and research in the field.
- Conocer en profundidad y comprender la organización a nivel molecular de células, sistemas y procesos de relevancia en las Ciencias de la Salud.
- Conocer en profundidad y comprender las bases moleculares de la enfermedad.
- Conocer en profundidad y comprender las metodologías de investigación básica aplicables a las Ciencias de la Salud.
- Tener capacidad de analizar y sintetizar un problema.
- Tener capacidad de comunicación oral y escrita en una segunda lengua científica.
- Tener capacidad de localizar información.
- Tener capacidad de desarrollar un trabajo interdisciplinar.
- Conocer y comprender los conceptos básicos y las aplicaciones en investigación básica y clínica del estudio de la Regulación del Metabolismo en Células de Mamífero.
- Conocer, comprender y aplicar en la práctica las técnicas de estudio de la Regulación del Metabolismo en Células de Mamífero en situaciones relacionadas con la investigación básica y clínica.

- Aprender a identificar, manejar y presentar adecuadamente en informes y exposiciones públicas, conocimientos existentes sobre el estudio de la Regulación del Metabolismo en Células de Mamífero, usando como vehículo la lengua inglesa.
- Aprender a identificar, manejar y presentar adecuadamente en informes y exposiciones públicas, conocimientos existentes sobre aspectos básicos y clínicos de señalización intercelular e intracelular, usando como vehículo la lengua inglesa.

LEARNING OUTCOMES

1. Understanding the basic concepts of metabolic regulation and the interrelationships that exist between different tissues of the body. The metabolic changes that occur in different physiological conditions (fasting, exercise etc.); and in certain pathological conditions (obesity, diabetes, vascular disease etc.).
2. Understanding methods used to study the metabolism in mammals
3. How to present experimental results.

DESCRIPTION OF CONTENTS

1. Overview of metabolism and their relationships intertisulares

Metabolic specificity of the different mammalian tissues. Energetic substrates present in the circulation and factors that control their use by tissues. Fate of substrates present in the circulation to a specific tissue. The use of energy substrates by tissues: regulatory signals. Overview of the intertissue fluxes of glucose, lipids and amino acids.

2. Genetic and epigenetic regulation of metabolism

Molecular mechanisms involved in epigenetic regulation of metabolism: chromatin structure, DNA methylation, covalent modification of histones and chromatin structure regulation. Epigenetic mechanisms involved in tissue metabolic specialization. Signal-transduction pathways and transcription factors regulated by energy substrates.

3. Integration of metabolism in intestinal cells

Anatomophysiological overwiew: Amplification of the absorbing surface. Energy substrates of the intestinal cell. Transport mechanisms. Intestinal cell metabolism. Interrelationship between the intestine and the liver.

4. Integration of hepatic metabolism

Hepatic zonation: periportal and perivenous hepatocytes. General functions of the liver. Metabolic characteristics of the postprandial-postabsortive cycle. Regulation of plasma proteins synthesis. Xenobiotic metabolism. Detoxification. Alcohol metabolism. Bile production. Enterohepatic circulation. Endocrine functions of the liver.

5. Integration of metabolism in white and brown adipose tissue

Anatomical features: regional heterogeneity. Metabolic activity of white adipose tissue: Randle cycle. The adipose tissue as a generator of regulatory signals: leptin, TNF and others. Substrates and metabolic activity of the brown adipose tissue. Role in thermogenesis. Regulation. Presence and significance of brown adipose tissue in humans.

6. Integration of metabolism in skeletal and cardiac muscle

Skeletal muscle metabolism. Metabolic differences between the various types of skeletal muscle fibers. Use of different circulating energy substrates. Muscle glycogen utilization. Metabolism of proteins and amino acids. Cardiac muscle metabolism and utilization of different substrates. Study of the signaling pathway during hypoxia in heart muscle.

7. Brain Biochemistry: Metabolic Aspects

Anatomical and metabolic compartments. The blood-brain barrier. Energy substrates. Techniques for the study of energy metabolism. Neurotransmitters: concept and types of neurotransmitters.

8. Molecular mechanisms regulating metabolism during exercise

Overview. Types of energy substrates. Special study of creatine-P. Definition of aerobic and anaerobic exercise. The oxygen debt or excessive consumption of oxygen after exercise: metabolic aspects. Fiber Types: Biochemical characteristics. Transformation of type II fibers to type I fibers: Role of AMPK/PCG1 pathway.

9. The mammary gland during involution, a model of programmed cell death

Introducción anatomofisiológica. Líneas celulares. Cambios fisiológicos durante la gestación, lactancia y destete. Redistribución de los nutrientes a la glándula mamaria especialmente aminoácidos y glutatión. Mecanismos moleculares implicados en la remodelación tisular de la glándula mamaria.

10. practical work

Each student will write a practical work on metabolic regulation to choose the list that will be proposed by the teacher at the beginning of the course, with specific instructions for their preparation. The work will be delivered before the end of the first semester of the academic year

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	20,00	100
Group work	15,00	100
Seminars	10,00	100
Study and independent work	30,00	0
Readings supplementary material	12,50	0
Preparing lectures	25,00	0
TOTAL	**112,50**	

TEACHING METHODOLOGY

Actual teaching of this subject will be made by the following methodological approaches: lectures, seminars and tutorial assistance.

EVALUATION

The evaluation of the knowledge acquired by the students will be done by:

1. A written test up to 50% of the total qualification.
2. Evaluation of the oral presentation of a review about a scientific paper up to 40%.
3. Interest of the student on the subject, up to 10% of total score.

REFERENCES

Basic

- J. Larry Jameson, Anthony S. Fauci, Dennis L. Kasper, Stephen L. Hauser, Dan L. Longo, Joseph Loscalzo. Harrison. Principios de Medicina Interna (20ª Edición) Mc Graw Hill

Additional

- Kaelin WG and McKnight SL. Influence of Metabolism on Epigenetics and Disease. Cell 153, March 28, 2013.
  doi: 10.1016/j.cell.2013.03.004
- Puchalska P and Crawford PA. Multi-dimensional Roles of Ketone Bodies in Fuel Metabolism, Signaling, and Therapeutics. Cell Metab. 2017 Feb 7; 25(2): 262-284.
  doi: 10.1016/j.cmet.2016.12.022.
- Burke LM and Hawley JA. Swifter, higher, stronger: Whats on the menu? Science 16 Nov 2018: Vol. 362, Issue 6416, pp. 781-787.
  doi: 10.1126/science.aau2093
- Daurio NA et al. Spatial and temporal studies of metabolic activity: contrasting biochemical kinetics in tissues and pathways during fasted and fed states. Am J Physiol Endocrinol Metab. 2019 Jun 1;316(6): E1105-E1117.
  doi: 10.1152/ajpendo.00459.2018. Epub 2019 Mar 26.

ADDENDUM COVID-19

This addendum will only be activated if the health situation requires so and with the prior agreement of the Governing Council

In the event that the health situation so requires:

A) Face-to-face teaching will be replaced by online teaching, through synchronous or asynchronous presentations by teachers of the teaching materials, using the tools made available to teachers and students in the Virtual Classroom.

B) The tutorials will be carried out exclusively telematically.

C) The final evaluation of the subject will be done through an online test.